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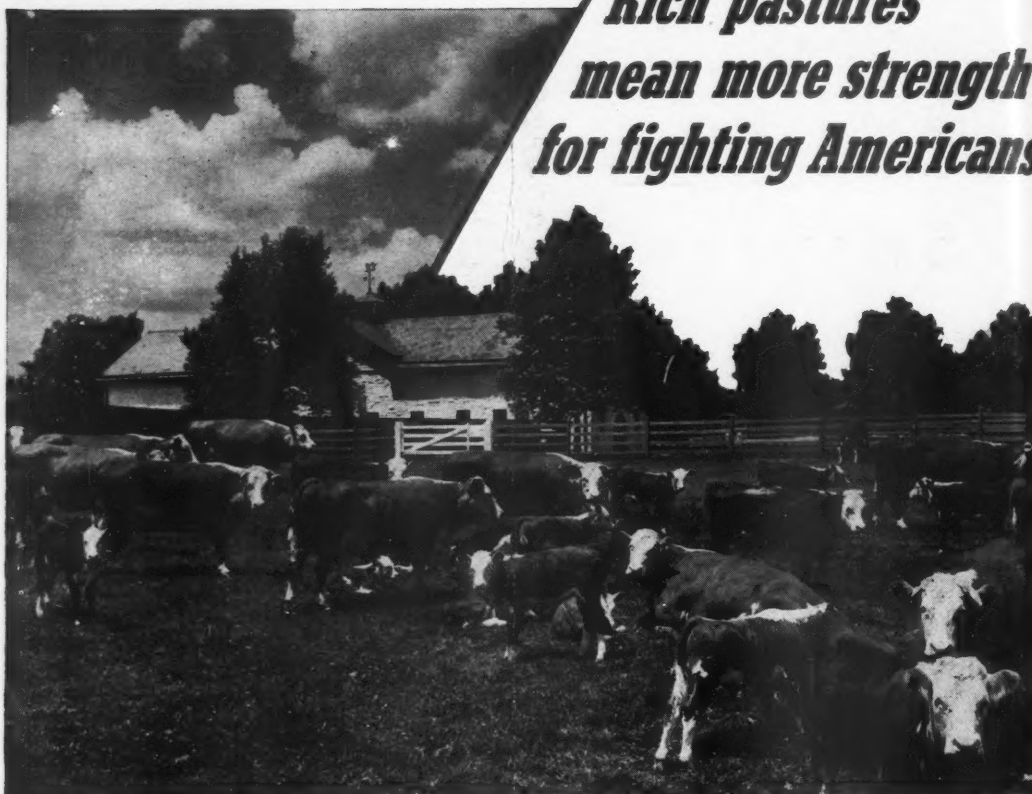

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...THE...

AMERICAN FERTILIZER

"That man is a benefactor to his race who makes two blades of grass to grow where but one grew before."

Vol. 101 OCTOBER 21, 1944 No. 8

Economics of Use of Dolomite in Neutral-Reacting Mixed Fertilizers*

By S. B. HASKELL AND LEROY DONALD

Barrett Division, Allied Chemical and Dye Corporation, New York, N. Y.

THAT continuous use of acid-producing nitrogen fertilizers, in generous amounts, brings about on many soils a condition inimical to satisfactory crop growth has long since been established. This condition is typically one remedied by use of lime or limestone. So also has it long been established that on many soils there can be developed no really economical farming industry, except as limestone or its equivalent is applied to the land. The inclusion of dolomite—used both because of its magnesium content, and because of its relatively low reactivity—in mixed fertilizer is, however, the result of research initiated less than twenty years ago, and brought to fruition in action by the A. O. A. C. at meeting held in November, 1935 (*7*),† when the modified Pierre method of determining acidity-basicity factor was accepted on a tentative basis. The present official method is indeed still classified as "tentative," but in the meantime neutral mixed fertilizers have come into being in large tonnages.

Authoritative data on the tonnage of neutral mixed fertilizers being produced are not available. Mehring and Vincent (*10*) report that for the calendar year 1941 slightly over 300,000 tons of "dolomite or limestone" were used in fertilizers manufactured in that year. For the purposes of this study we are assuming that this dolomite was used in neutral mixed fertilizers. Since the consumption of mixed fertilizer nitrogen in the 1943/44 fertilizer year was almost exactly 50 per cent higher than in 1941, we arrive at an estimate of 450,000 tons of dolomite or equivalent as having possibly been used in 1943/44.

Study of tonnage of nitrogen materials allocated for use in 1943/44 mixed fertilizers indicates an average net acidity of 3.5 tons of calcium carbonate equivalent, per ton of nitrogen. Since some 300,000 tons of nitrogen were contained in the mixed fertilizer used east of the Rockies in 1943/44, it appears that, had all of this nitrogen been neutralized according to accepted methods, over a million tons of dolomite would have been required.

The estimate of 450,000 tons of dolomite or its equivalent, as being contained in fertilizers in 1943/44, is probably more nearly accurate than the assumption that it was all used to neutralize the physiological acidity of nitrogen carriers. In any case it is interesting, and may be valuable, to compare the magnitude of this figure with other figures having to do first with the need of neutralizing materials, and with actual use.

As to need, South Carolina (*1*) estimates that 1,601,500 tons of limestone are needed annually in that State alone, in order that the manpower on South Carolina farms may be more adequately rewarded in terms of crop produced, and that the fertilizer investment for South Carolina farmers may bring greater dividends.

Or, considered from a national standpoint, we quote from a recent report of the Chief of Agricultural Adjustment (*14*):

*Presented before the Division of Fertilizer Chemistry, American Chemical Society, New York, September 12, 1944.

†Numbers in parenthesis refer to Literature cited at end of the paper.

"From 1936 through 1942, the total amount of limestone used by farmers cooperating in the program in Continental United States was 63,915,000 tons. This rose from 3,620,000 tons in 1936 to 18,971,000 tons in 1942."

Interpreting some of these figures, the 450,000 tons of dolomite which may have been used in mixed fertilizers in 1943/44 were sufficient for the production of about 3,000,000 tons of neutral mixed fertilizers averaging 4 per cent nitrogen. But if all mixed complete fertilizers had been neutralized, the total amount of limestone added to the soils of the country would still be only two-thirds as much as believed needed annually by South Carolina farmers alone; and only about 6 per cent of the limestone used in 1942 by farmers then cooperating with the Agricultural Adjustment Agency.

Limestone as such is used to raise the *p*H value of the soil to a desirable level. The dolomite in mixed fertilizers, when used to bring about conventional "neutrality" according to the Pierre formula, is used, at least in theory, for the purpose of protecting the soil against that depletion of bases which may be expected to result from continued use of acid-reacting nitrogen carriers. In studying the economics of use of dolomite as a neutralizing material we must bear in mind this difference in function. We must also consider the economic repercussions should the perhaps unfortunate name "neutral complete fertilizer" be interpreted by users as indicating no need for additional lime.

Field Comparisons on Cotton

If one may judge by the mass of field comparisons, acid *vs.* neutral fertilizer mixtures, which has been published, the South is much more interested in dolomite in mixed fertilizers than is the North; and, by the same token, there is more interest in neutral fertilizers for cotton than for any other crop. The amount of comparative work on other crops is in fact too small to enable us to draw sound deductions. In evaluating the significance of crop increases (or decreases) arising from the use of dolomite in these neutral mixtures, we are therefore confining our study to cotton.

As an average of eleven 5-year tests on soils of a sandy texture, Mississippi (*3*) reports an increase of 90 pounds of seed cotton per acre, from the use of neutral mixed fertilizer supplying approximately 100 pounds of dolomite per acre, as compared with an acid-reacting mixed fertilizer of the same grade.

Georgia (*9*) reports the following results:

Soil Area	No. of Tests	Increase Due to Dolomite Lbs. Seed Cotton per Acre Aver.	1st Yr.*	Last Yr.*
Coastal Plain....	1,586	48	23	71
Piedmont........	811	63	31	111
Limestone Valleys	383	67	77	206
Average all soils..	2,780	53	34	106

*One-year results omitted.

Alabama (*15*) reports an increase of 53 pounds seed cotton per acre as the average of 185 experiments in four years, on six major soil areas in the State, when the fertilizer was approximately neutralized, first with marble dust, in the later years with dolomite.

It will be noted that on an acre-basis differences in yield between the neutral and acid-reacting mixtures were typically of small magnitude. So also were the amounts of dolomite applied per acre in the mixed fertilizer. Mississippi (*4*) has carried through interpretation of results to calculation of additional yields which could be expected per ton of neutral mixed fertilizer spread over five acres. We quote:

"On the basis of these results, one ton of neutral fertilizer applied on five acres of sandy-textured soil would produce an increase over acid fertilizers of 450 pounds of seed cotton.

"Perhaps half the total tonnage of fertilizer purchased in Mississippi is utilized in cotton production on soils of a sandy texture."

Bear in mind that the figures cited represent many comparisons, but chiefly short-period comparisons. Let us call to mind the theory involved—"to protect the soil against depletion of bases"—and ask ourselves if a short-term test can adequately measure the degree of protection secured. The Georgia results already cited indicate a cumulative plus effect. Collins and Skinner (*8*) report a four-year test on Norfolk sandy loam, in which the average increase of seed cotton per acre was 293 pounds. It is interesting to note the sequence of crop response as the experiment progressed—respectively a gain for the neutral fertilizer over the acid mixture of 175, 349, 466 and 184 pounds seed cotton per acre.

At this point comes an interesting question—are the results reported due to the fact of "neutrality" or to added supplies of Ca and Mg? The following quotation from Mississippi (*5*) bears on this problem, even though it does not answer the question:

"It was believed in the beginning that the relative degree of acidity, or *p*H reading, might determine crop response to lime application, or neutral fertilizers. Only in the

broadest sense was such the case. There was a very limited relationship between the *p*H level and response to lime. While high-lime soils gave negative results, some slightly acid soils showed increases while others showed decreases, and some very acid soils followed the same variable response pattern."

Not all of the results were positive. In carrying through work similar to that already reported, Mississippi (*6*) found that, as an average of six 5-year tests on soils containing considerable quantities of silt and clay fractions, there was an apparent loss of 22 pounds seed cotton per acre from the neutral mixtures as compared with the acid mixtures.

Skinner (*12*) reports results of a 1-year test on seven different North Carolina soil types, in which acid *vs.* neutral 4–8–4 was compared, likewise acid *vs.* nentral 8–16–8, to give equivalent plant food, and an additional acid mixture fortified with calcium sulphate. The average yields of seed cotton were as follows:

Plot No.	Average of Seven Soil Types	Lbs. Seed Cotton Per Acre
1	Acid 4–8–4	1,466
4 and 5	Neutral 4–8–4	1,437
6 and 9	Acid 8–16–8	1,522
7	Neutral 8–16–8	1,594
8	Acid 8–16–8 fortified with calcium sulphate	1,748

The pronounced effect of the gypsum, which could have no effect on soil reaction, is at least interesting, and may be significant despite the fact that only a one-year test is being reported, in view of the fact that Albrecht (*2*) challenges the philosophy back of "neutral mixed fertilizers," and gives vigorous support to the contention that crop effect derived from adding additional calcium and magnesium is the main benefit, rather than effect on reaction. He presents illustrations to show that, where additions are made in a form which cannot affect soil reaction, the benefit is not adversely influenced. If we accept Albrecht's views, the term "neutral mixed fertilizer" is misleading, and hence dangerous in possible influence on practices of fertilizer consumers. Albrecht also mentions a point which may be of great importance, although not within the purview of this paper—that the localized application of calcium and magnesium compounds as applied in mixed fertilizer may give to the small quantities applied a value greater than could be expected were these quantities mixed with the body of the surface soil. This possibility has not been adequately explored.

Broadly, even on cotton, a crop of but moderate acre-value, there seems no doubt but that use of dolomite in fertilizer mixtures, at least on soils of a somewhat open texture, has given returns far beyond any possible additional cost arising from use of such dolomite; and we say this before giving consideration to cost! Were profit in use all that is involved in the study of economic relations, the discussion could well close at this point.

Other factors are involved. One of these is the fact that presence of dolomite in a mixture being ammoniated may increase reversion of phosphoric acid, and to this extent tend to decrease the amount of anhydrous ammonia, our lowest-cost carrier of fixed nitrogen, which can be used. United States Department of Agriculture (*13*) makes the following statement:

"Results from greenhouse experiments with specially prepared ammoniated materials performed at a number of State experiment stations all agree that 5 per cent mixtures of ammonia in superphosphate are less effective in promoting plant growth than mixtures ammoniated at lower rates. Ammoniation to 4 per cent produces no serious decrease to phosphorous availability, if other conditions are not favorable to reversion of phosphate. Decrease in availability results from high temperature or moisture conditions or the presence of dolomite at temperatures of 60 degrees Centigrade (140 degrees Fahrenheit), or above."

More important probably is the danger incident to depending on neutral mixtures alone for the necessary supplies of calcium and magnesium. In theory at least, the dolomite used in such mixtures can do no more than leave the soil where it was. Unfortunately we have been unable to find in the literature any truly comprehensive research which bears on relative economics of annual applications of small amounts of limestone (as in neutral mixed fertilizer) *vs.* more infrequent but larger applications when limestone is used primarily to adjust soil reaction.

Costs

Having attempted an estimate of benefits derived from the presence of neutralizing dolomite in mixed fertilizers for cotton, we now have to make estimates of cost. A typical viewpoint, expressed time and again by experiment station workers, is that since dolomite costs little if any more than the sand which it may replace, no significant extra cost

(Continued on page 28)

New Sulphuric Acid Plants Recommended

Construction of new facilities for the production of sulphuric acid to meet increased requirements of the Office of the Chief of Ordnance of the War Department was recommended by the Inorganic Acids Industry Advisory Committee at a recent meeting.

The committee emphasized that in view of existing tank car shortages, these facilities be erected in areas where the acid is needed to prevent excessive hauling over long distances.

Estimated requirements of industry for new and spent acid for 1944 are 10,556,200 tons, against a supply of approximately 9,659,700 tons, WPB told the committee. For the first six months of 1945, requirements will be 5,663,600 tons with an estimated supply of 5,251,000 tons, they added. These figures are exclusive of production and requirements of the Office of the Chief of Ordnance.

Projects now under way are expected to bring the capacity of the industry to a peak of 9,426,600 tons on June 30, 1945.

WPB told the committee that there is an anticipated annual shortage of from 30,000 to 50,000 tons of acid in the Chicago area. Plans for two new plants have been submitted to WPB by industry to alleviate this shortage, they said. The committee suggested that WPB approve one project for this area.

WPB said plans were submitted for three new plants in the St. Louis area to prevent an anticipated annual shortage of 150,000 tons of sulphuric acid in that area. The committee recommended the construction of all three projects. The projects under WPB consideration follow: Monsanto Chemical Corporation, East St. Louis, Ill., to produce from 70,000 to 75,000 tons annually; National Lead Company, East St. Louis, Ill., to produce from 70,000 to 75,000 tons annually; and General Chemicals Company, Newell, Pa., to produce oleum (concentrated sulphuric acid) to balance the over-all shortage.

New facilities to meet military requirements should be erected at the discretion of the Office of the Chief of Ordnance of the War Department, the committee said. The Office of the Chief of Ordnance is considering the construction of Government-owned plants in the following cities and with the following capacities: Charlestown, Ind., 75,000 tons of sulphuric acid annually; Tyner, Tenn., 75,000 tons of sulphuric acid annually.

Discussing the supply of tank cars, WPB officials told the committee that shortages in transportation facilities are expected to become more severe. In 60 days, industry will be short from 100 to 150 tank cars, they pointed out. The Office of the Chief of Ordnance reports that 175 additional tank cars will be required to meet November schedules. According to the present combined requirements (industry and military), between 700 and 800 new tank cars will be necessary by March 1, 1945. WPB is studying the problem of obtaining more tank cars.

WPB officials predicted that when the plants now under consideration are constructed, more spent acid will be available for the production of larger quantities of superphosphate, which is critically needed for the manufacture of fertilizer for agriculture.

Wischhusen To Direct Manganese Research

J. F. Wischhusen has resigned his position as division manager for the Harshaw Chemical Company at its Cleveland, Ohio, office and is now director of a Manganese Research and Development Foundation sponsored by the Tennessee Eastman Corporation, Kingsport, Tenn.

Until he has completed a survey of soil needs of manganese to determine the location of his headquarters, Mr. Wischhusen will operate from his home at 15031 Shore Acres Drive, Cleveland 10, Ohio. His work will involve cooperation with other agencies conducting researches directed to the improvement in quality and quantity of crops through the application of manganese sulphate, which the Tennessee Eastman Corporation is developing under the name, "Tecmangam."

Mr. Wischhusen became interested in soil fertility when he became president of the Superfos Company at the time of its foundation in 1920. When he went with the Harshaw, Fuller & Goodwin Company in 1928, he carried with him a keen interest in the role of minor mineral elements—manganese, copper, cobalt, fluorine, iodine, and others—in the maintenance of balanced fertility. His theory is that these elements should constitute approximately 5 per cent of the composition of the plant food used to maintain proper soil conditions for optimum crop production.

Humus-The Working Partner of Chemical Plant Food

By VINCENT SAUCHELLI

Agronomist, The Davison Chemical Corporation

"If all the accumulated soil-management wisdom of a hundred generations of master farmers were boiled down to just three sentences, one of those sentences certainly would be: provide for regular and frequent replenishment of the supply of organic matter in the soil."

—John B. Abbott.

YOU may have heard John Abbott of Vermont discuss the humus problem. If so, you will admit it was a rare treat. Several years ago when he was actively engaged in promoting the use of one of the commercial nitrogen-carriers, John Abbott prepared a booklet in which he humbly believed he had solved the baffling problem of the role of humus in crop production. The above quotation is one of the many gems in that brochure. Time and again in booklet, bulletin, journal article and speech, representatives of the commercial fertilizer industry have emphasized that humus is an essential part of the soil, so much so that without it a soil is not fit for agricultural use. Extension agronomists and research agronomists have been engaged for years and years in proving by field plots and pot tests in all parts of the world the essential need of humus in crop soils. This is common knowledge to all agricultural workers. Yet, strange as it may seem, there are some persons, assuming to speak with authority, who seem willfully to ignore the facts and choose to criticize the fertilizer industry for alleged failure to recognize the role of humus in crop production. The charge is unwarranted. Reference to farm journals and other pertinent literature would quickly give the lie to such criticism.

In what follows an attempt will be made to show the close working partnership between humus and chemical plant foods in profitable agriculture. The same story has been told many times before; but its message bears repeating and re-emphasizing if we are to judge by the statements of the critics previously mentioned and the claims of certain "organic matter" cultists.

Organic Matter and Humus

We commonly use the word "humus" interchangeably with the phrase "organic matter." Perhaps because it is shorter. Most often what we really mean to say is "organic matter." The organic matter of the soil comprises freshly received, actively decaying plant and animal residues, and the older, more slowly decaying portion which, already having passed through the active stages of decay, is nearing the stage of complete decomposition. Humus is the term applied to this latter stage. It is extremely difficult to draw a line dividing the two classes of organic matter. Humus has been defined as "soil organic matter that has undergone decay to the extent that it has lost its identity." That is a good practical definition. Technically, humus is characterized by a certain ratio of the element carbon to nitrogen. In humid regions this ratio averages about 10 to 1, and in semi-arid climates it averages higher but seldom exceeds 14 to 1. In the following discussion we shall use the phrase "organic matter" rather than the term "humus" unless it is necessary to be specific and technical.

Function of Humus

Nature builds soils of many kinds—some poor, such as sands and gravels; some rich, such as clays and loams. As soon as they are laid down they are subjected to the effects of its agencies—sun, wind, air, water and plants, animals and soil organisms. Both physical and vital agents affect soils favorably and destructively. Soil bacteria invade them and as they assimilate the nitrogen of the air, they grow and multiply and die, leaving in the soil a rich legacy of nutrients for the growth of plants. Plants become established, feed on the bacterial legacies of plant food, grow, multiply and die returning thereby to the soil increasing supplies of organic matter which serves to feed soil organisms. And so the cycle goes on and on. Thus the original dead mineral earth is transmuted into living soil suitable for agriculture.

Soil is indeed a living thing. Farm soils

contain billions upon billions of bacteria and other living organisms. We must keep this fact in mind as we inquire into the causes leading to the fertility or sterility of a soil. The fertile soil in which a crop is struggling to establish itself is the battleground of these myriad armies of bacteria and the crop rootlets: both contending for the available mineral food, the water, and the nitrogen. The soil organisms take their full share of the available food which the crop also must have. Unless there is enough for both, the crop comes out second best and usually at a time when it needs that food most urgently. But these organisms are not really enemies of the crop. As previously mentioned, they assimilate the raw mineral elements which, as such, are not always suitable for plant nourishment, make food substances out of them, and these they share with the plant. Upon death the bacteria further benefit the plant by bequeathing to it the substance of their bodies and food which they hoarded during their brief life span.

Organic matter, of course, serves in other ways to make soils productive besides furnishing plant food. It increases the water-holding capacity: soils high in organic matter resist drouths more effectively. It improves the tilth of a soil: makes it possible to work heavy clay soils into satisfactory seed beds. It reduces soil erosion.

Manure

Barnyard manure is one of the best sources of organic matter. Its application to soils is one of the oldest methods known for improving fertility. Manure is rich in organic compounds containing carbon and nitrogen. Some investigators, in fact, believe the carbon is the more valuable part of manure. Soil bacteria utilize the carbon together with nitrogen and phosphates in building their own body substance which upon their death and decomposition is released as plant nutrients.

Organic matter as such is not a direct plant food: bacteria must first decompose it into simple end products such as water, carbon dioxide, nitrogen, ammonia and mineral salts. These simple end products constitute the food of plants.

Good as manure admittedly is, it cannot be considered a balanced, complete plant food. It is relatively rich in nitrogen but poor in minerals, especially phosphates. The farmer who applies 10 to 15 tons of it to the acre may think he is giving the crop all the food it needs. Perhaps he may be giving enough nitrogen. That depends upon the crop. He is not supplying enough phosphates and potash. The universal experience of investigators and most farmers is that the use of farmyard manure alone is wasteful and unjustified. For maximum returns the manure must be supplemented with phosphates, and very often with potash.

A reference to field tests illustrates this. Typical of what happens from the use of manure alone and reinforced with fertilizer are the results in Table 1, as reported by Dr. Firman E. Bear. In this test 8 tons of manure were applied to the clover sod in a three-year rotation of corn, wheat and clover. Limestone had been used as needed to get a good stand of clover.

TABLE 1*

26-YEAR AVERAGE ACRE YIELDS WITH 8 TONS OF MANURE ON CORN

(Ohio Experiment Station)

Treatment	Corn Bushels	Wheat Bushels	Clover Cwt.
Phosphated manure.....	67.7	28.6	49.0
Stall manure...........	61.9	23.8	41.5
Open-yard manure......	55.9	22.8	36.6
No manure.............	36.8	14.2	29.4

**Soils and Fertilizers*, 3d Ed., F. E. Bear.

At the Petersburg, Virginia, Experiment Station they found that a good crop of crimson clover turned under increased the corn crop by 17.6 bushels as compared with land where no clover was grown. But when the crimson clover had been fertilized and then turned under, the corn crop was increased by 39.6 bushels or a gain of 22 bushels over the unfertilized crimson clover. Here, again, organic matter alone did not supply a balanced food ration. Best results occurred when the organic matter was supplemented with chemical fertilizers.

These tests are merely typical of thousands of others whose results support what is here stressed about the partnership between fertilizers and organic matter.

Humus Renewal

Cultivation of a soil creates conditions favorable for decay and depletion of the soil organic matter. Unless replenished the original store of organic matter rapidly declines to the point where crop returns are no longer profitable. Because of the scarcity of farm manure, it is necessary to turn under crop residues and green manure crops to keep up the supply. It is in this connection that chemical fertilizers make one of their best contributions. In the case of the continuous

(Continued on page 26)

IT MAY BE

By SAMUEL L. VEITCH

G. I. Schools in Europe

Colonel Lawrence Westbrook, Assistant Director of the War Department's Planning Division, in a recent talk outlined the War Department's educational program for service men in the European Theatre, between the time hostilities cease and the time transportation home is available. Schools are to be established at battalion levels and a wide variety of general, technical and vocational courses will be offered. These will probably be supplemented by organized travel tours to places of historical interest in the European countries for those who are interested. This program is purely a War Department one, and should not be confused with the educational opportunities offered to veterans under the "G. I. Bill of Rights." The War Department indicates many of our men in Europe might have to mark time after the V–E Day, because at that time our shipping will have to concentrate on taking troops and supplies from the European-African zone to the Pacific.

Selective Service Rejections

A great many pessimistic conclusions had been drawn from the huge total of more than 4,000,000 Selective Service rejectees, but the testimony before the Senate Sub-Committee is very encouraging. Colonel Leonard G. Rowntree, head of the Medical Division of Selective Service, said emphatically that rejection rates do not reflect the health of the Nation. He explained why it was impossible for the Army to classify rejectees as due to trivial, or to remedial, or to severe physical problems. Many rejections are trivial from a medical viewpoint, for instance 250,000 were illiterates with no physical handicap at all, just lack of education. There was found to be a considerable variation in the "toughness" of examinations, given by the 33,000 doctors and 10,000 dentists who have served Selective Service without remuneration. It is stated some 200,000 persons a year are discharged from the Armed Forces for neuro-psychiatric reasons. Everyone should keep in mind that there is a wide variation in cases coming under the general head of neuro-psychiatric. Many of them are extremely minor, and will in all probability never impair the efforts of the individual, particularly if he can find the proper type of employment and congenial surroundings.

Government Real Estate

If you have been considering purchasing a piece of property from the Government when it becomes available, now is the time to get in touch with your nearest RFC office. Plans for the sale of war factories are now being considered. There should be some real buys.

G. I. Joe's Rights

The earliest date on which compensation can be paid for unemployment under the terms of the "G. I. Bill of Rights" is September 4th, and after September 4th, any unemployed or partially unemployed veteran can file at the State Employment Office, or if he is a railroad man, at the Railroad Employment Office. It will be a week before his compensation starts. Of course, after September 4th, any veteran can file at once, any time he is unemployed, or partially unemployed. To enable the educational features to get under way at once as much as possible, the Veterans Administration has prepared a form called "Veteran Administration Rehabilitation Form 1950." This form can be obtained from the Veterans Administration in Washington, or any of its regional offices, or from veterans organizations. When filled out, this form may be filed with the Veterans Administration or with the school or college the veteran wishes to attend. The Administration will notify the veteran when it is approved. However, a veteran can matriculate without waiting for this approval, but the Government will not pay expenses until it has established the applicant's eligibility.

Spinach

The kids will love this, but Popeye is going to be awfully angry. The Department of Agriculture has recently come to the conclusion the oxalic acid in spinach is not good for the bones or teeth. So, the first thing you know, they will be telling us we can't have parsnips. Wouldn't that be too bad?

THE AMERICAN FERTILIZER
ESTABLISHED 1894
PUBLISHED EVERY OTHER SATURDAY BY
WARE BROS. COMPANY
1330 VINE STREET, PHILADELPHIA, PA.

A MAGAZINE INTERNATIONAL IN SCOPE AND CIRCULATION DEVOTED EXCLUSIVELY TO THE COMMERCIAL FERTILIZER INDUSTRY AND ITS ALLIED INDUSTRIES

PIONEER JOURNAL OF THE FERTILIZER INDUSTRY

WARE BROS. COMPANY
PUBLISHERS
1330 VINE STREET PHILADELPHIA, PA.
A. A. WARE, EDITOR

ANNUAL SUBSCRIPTION RATES

U. S. and its possessions, also Cuba and Panama	$3.00
Canada and Mexico	4.00
Other Foreign Countries	5.00
Single Copy	.25
Back Numbers	.50

Vol. 101 OCTOBER 21, 1944 No. 8

Principal Articles in This Issue

The Fertilizer Outlook

The stepping-up of the munitions program in recent months has affected superphosphate production and the supply of nitrogen available for use as fertilizer, according to the National Fertilizer Association. For many months the superphosphate industry has been getting a considerable quantity of sulphuric acid from Ordnance plants, but this supply has now been greatly curtailed. In fact, it is now indicated that the total superphosphate supply for the year may be less than last year, although not enough less to interfere seriously with the production of mixed fertilizers.

Fixed nitrogen produced in Government war plants was until recently being converted into nitrogen solutions for use in mixed fertilizers and into ammonium nitrate, but this nitrogen is now being used in munitions manufacture and the supplies of these materials available for fertilizer use this coming year will be very much less than last year unless there is a change in the munitions program.

Shipping priority has been granted for importing 850,000 tons of Chilean nitrate this year as compared with about 600,000 tons imported last year, and this increase will offset a considerable part of the reduction in other nitrogen supplies.

Labor is another factor which is tending to handicap the production of mixed fertilizers and certain materials. The labor situation is critical in the phosphate rock mines, in superphosphate plants, and in mixing plants in all parts of the country.

An early termination of the war in Europe would tend to increase fertilizer supplies. More sulphuric acid would be available for making superphosphate; more nitrogen solutions and ammonium nitrate could be produced; and due to cut-backs in war plants more labor would be available to fertilizer plants. Fortunately there was a considerable carryover of mixed fertilizer from last season in many sections of the country, and mixing plants have been running to capacity all summer. It will therefore be possible for most if not all fertilizer companies to ship fertilizer for spring use this fall and winter if farmers will order it early and accept delivery. This was done last year with the result that many farmers got fertilizer who would not have gotten it otherwise. Early move-

ment of fertilizer is more important this season than last.

There is every assurance that the total potash supply will be equal to total demand, but the supply of sulphate of potash may be short in a few areas. It is also possible that in some localities where an unusual demand has developed during the past two or three years the total potash supply available for that locality may be insufficient. It is the general belief, however, that nearly everywhere the supply will be adequate for use in mixed fertilizers of any desired potash content and for direct use also.

Swift Building New Fertilizer Research Laboratory

Construction of a new research laboratory and model pilot plant at Swift & Company's plant-food factory at Hammon, Ind., has been announced by C. T. Prindeville, vice-president in charge of the company's fertilizer operations. Foundation footings for the steel and brick structure have been poured.

"The new laboratory and pilot plant will serve as research headquarters for the 17 Swift plant-food factories in the United States, with special attention directed to manufacturing problems and product improvement," Mr. Prindeville declared in announcing the new project. "The most modern equipment and facilities available will be incorporated in the new building. The new building will provide an opportunity for our scientists to carry out small-scale research in the laboratory and to continue these same projects in the pilot plant where studies can be made under factory conditions."

Analytical laboratories will continue to be maintained at each Swift plant-food factory to check standards of products processed at each unit. Another Swift research laboratory is maintained at Bartow, Fla., and the company's phosphate mine. Here the research is directed toward securing maximum yields from the phosphate deposits and producing a product of a higher phosphate analysis.

Dr. H. B. Siems will continue to direct the company's over-all plant-food research program, while Dr. C. H. Davenport will be in charge of the new laboratory and pilot plant operations.

War Production Board approval has been given to the project which is expected to be completed in about three months.

DuPont Ammonia Department Makes Changes in Staff

Dr. E. D. Ries, recently appointed director of sales of the Ammonia Department of the du Pont Company to succeed R. W. McClellan, now special assistant to F. W. Wardenburg, general manager, announces several staff changes of special interest to the fertilizer and feed industries.

J. B. S. Holmes, formerly district sales representative for the Northeastern States, has been named assistant sales manager of the Nitrogen Products Section of the Sales Division, with headquarters in Wilmington, Del. E. A. Hedin is sales manager of the Nitrogen Products Section.

Dr. F. G. Keenen, formerly leader of the Ammonia Department's Chemical Division group of Agricultural and Food Chemicals at the Experimental Station, has been transferred to the Technical Section of the Sales Division, of which Dr. H. R. Dittmar, formerly of the Chemical Division staff, is the recently appointed head.

Dr. Keenen succeeds Ward H. Sachs, who is returning to Orlando, Fla., as district sales representative for Florida and Georgia. Mr. Sachs was on temporary assignment in the Wilmington office, replacing Dr. F. W. Parker, who resigned two years ago to join the United States Department of Agriculture at Beltsville, Md. Dr. Keenen is succeeded by Dr. D. K. O'Leary, who has been a member of the Agricultural and Food Chemicals research group for several years.

Are You Interested in Foreign Fertilizer Business?

We have received a letter from one of our foreign subscribers, a cooperative society, looking forward to the resumption of normal foreign trade. They will require considerable quantities of a number of fertilizer materials, such as sulphate of ammonia, nitrate of soda, nitro chalk, nitrate of lime, sulphate of potash, dried blood, hoof and horn meal, fish meal, bone meal, cyanamid, urea, ammonium nitrate, basis slag, normal and concentrated superphosphates, and mixed fertilizers, and are interested in making contacts with suppliers of these materials. We will be glad to furnish the name and address of the subscriber to any company interested.

The Need for Borax on Fourteen Crops*

By D. E. DUNKLEE and A. R. MIDOLEY

Agriculture Experiment Station, Burlington, Vermont

(Continued from the October 7th Issue)

Other Nutritional Possibilities

There is a real possibility that stem-end browning, net necrosis, leaf roll, and ring-rot diseases of the potato, as well as blackening of cooked tubers, are nutritional diseases, or that susceptibility to them depends on nutritional factors. There is also a good possibility that bitter pit of apples is a nutritional disease regardless of failures to date to correct it with fertilizers. Nutritional investigations are being made at the Vermont Station to discover practical remedies for the diseases that so badly baffle potato growers. Present measures are not adequate because in spite of all that has been done to tuber-unit, index, and isolate seed potato plots, potato diseases are increasing and becoming more troublesome. In fact, in 1943 there was more net necrosis than ever before in some Vermont lots entered for certification, a 50 per cent infection in one and 15–30 per cent in others. Ring rot has invaded the Northeast before other older problems are well solved.

Potato growers need research help and need it badly. Nutritional research has an advantage over many other types because positive results once obtained can be directly put into effective field practice. Also many good crop varieties are losing ground because of diseases to which they have become susceptible. A new and resistant variety eventually is bred, in a short time likewise breaks down, and this requires more breeding. The degradation and breeding process goes on and on. The real remedy may be nutritional, the use of proper fertilizers to replace those plant-food elements lost by leaching and removed by crops from the soil. If the fertility could be replaced, much breeding work might well be avoided, and food crops with better nutritive quality could be produced. The Green Mountain potato, for example, is now going down hill fast due to susceptibility to disease.

Stem-End Browning

Chandler recently reported a brown coloration in potato tubers resulting from boron starvation in sand cultures. It was identical in appearance with the "stem-end browning" disease of the potato (2). There are many who will tend to doubt that boron is the answer to stem-end browning until it is demonstrated in field experiments. To the writers, this finding is not surprising, since they obtained the same color of browning affecting nearly all of the tuber tissues as a result of more severe boron starvation. Although our results were not the same as those of Chandler, our findings and experience tend to support him.

The work of Dennis in Scotland gives further support (*3*). Boron corrected a localized browning generally at the heel end of the tuber. "At the heel end" from Dennis means the same as "stem-end," as we understand it. It is highly desirable to determine whether

(Continued on page 24)

FERTILIZER MATERIALS MARKET

NEW YORK

Additional Allocations of Sulphate of Ammonia Made. Some Buyers Fail To Take These Added Deliveries. Superphosphate Production Drops Slightly. Some Reserves of Phosphate Rock Accumulating.

Exclusive Correspondence to "The American Fertilizer"

NEW YORK, October 17, 1944.

Sulphate of Ammonia

Additional allocations have now been made, a total of 50,000 tons having been released under this allocation for use in mixing only. It is expected that in most cases buyers will order up to the full amount allocated, but in some few instances buyers will not take delivery of additional allocation, either due to lack of certain other raw materials or due to additional purchases of uramon.

Superphosphate

The August production of this material was approximately 5 per cent less than production in August, 1943. This is undoubtedly due to the labor situation and also to the scarcity of sulphuric acid.

Potash

All producers are now delivering fully in line with allocations made. In spite of the manpower shortage, production is holding up and it is expected that ample quantities of muriate will be available.

Phosphate Rock

Deliveries are being made in substantial quantities but, due to the sulphuric acid shortage as well as manpower difficulties, acidulators are not taking all supplies available.

Bradley & Baker Move Jacksonville Office

On October 18th, Bradley and Baker, brokers and importers of fertilizer materials and feedstuffs, moved their Jacksonville office to new quarters in the Barnett Bank Building, Jacksonville 2, Fla. The main office of the company is at 155 E. 44th Street, New York, and other branches are located at Baltimore, Norfolk, and St. Louis.

BALTIMORE

Shortage of Ammonia and Superphosphate Expected. Increased Nitrate of Soda Imports Hoped For. Superphosphate Situation Tight.

Exclusive Correspondence to "The American Fertilizer"

BALTIMORE, October 17, 1944.

With no prospect in sight of any improvement in the labor situation, fertilizer manufacturers are now basing up materials for the coming spring season's business. Unless there is some change in the war situation, all indications point to an ammonia shortage, as well as possibility of scarcity of superphosphate.

Ammoniates.—There is no change in the market on tankage and blood and, while the demand for feeding purpose is not as urgent as it has been, the ceiling price for fertilizer is still so high as to be almost prohibitive for use in mixtures.

Castor Pomace.—Manufacturers are still sold up and not taking on any business except from regular customers.

Fish Scrap.—The end of the fishing season on the Chesapeake Bay is now in sight and there will probably be no stocks carried over, as it is reported that all contracts booked "subject to catch" will hardly be completed, due to the poor catch during the past month or so.

Sulphate of Ammonia.—While there has been a slight improvement in the tonnage allocated to fertilizer manufacturers for mixing purposes, it now looks as though allocations of sulphate as well as liquid ammonia will probably leave a gap which will be impossible to fill for the next spring season.

Nitrate of Soda.—Fertilizer manufacturers are hopeful that imports will be increased to such an extent as to fill in the deficiency created by the decreased production of sulphate and liquid ammonia due to war requirements. The market remains unchanged,

but deliveries are still being made under allocations.

Superphosphate.—The situation in the market on sulphuric acid is very tight and this in connection with the labor situation will make for a very firm market on superphosphate for the coming spring. In fact, none of the manufacturers are taking on any business except from regular customers, and the nominal price of 65 cents per unit of A. P. A., in bulk f. o. b. producers' works, still prevails.

Potash.—There is no change in the situation and deliveries are being made against contracts.

Bone Meal.—Both raw and steamed bone meal are in short supply, and at the market are being used for feed rather than for fertilizer purposes.

Bags.—With the easing up on restrictions surrounding the use of burlap for fertilizer purposes, there is no question but what a larger quantity of burlap will be used during the coming spring season than was utilized last year. Price ceilings placed by the Government on burlap continue unchanged.

CHARLESTON

Little Organic Material on Market. More Ammonium Nitrate from Canada Promised. Phosphate Rock Shipments Adequate to Date.

Exclusive Correspondence to "The American Fertilizer"

CHARLESTON, October 17, 1944.

The last estimate of the cotton crops in this section turned out even better than expected but the question remaining is whether or not the farmers will be able to gather it on account of the shortage of labor.

Organics. — These materials are scarce. There are no offerings of nitrogenous tankage, or castor pomace, and only occasional offerings of hoof meal.

Ammonium Nitrate.—Though the Canadian producers have agreed to increase their shipments by 20,000 tons, this will only be of assistance in the eastern part of the United States.

Nitrogen Solutions. — Fertilizer manufacturers making base goods for the coming season are still very much handicapped on account of their quotas of solutions having been cut.

Phosphate Rock.—The producers are so far able to fill the calls from superphosphate manufacturers although they are having considerable difficulty on account of shortage of labor. Most authorities now are convinced that fertilizer manufacturers will not be able to produce the hoped-for tonnage on superphosphate, due to shortage of labor and of sulphuric acid.

PHILADELPHIA

Market Quieter with Better Supply of Some Materials. Prices on Organics Generally Beyond Fertilizer Levels.

Exclusive Correspondence to "The American Fertilizer"

PHILADELPHIA, October 16, 1944.

The general over-all picture in this section remains just about in the same position as previously reported. The activity has quieted somewhat, and some materials are not as scarce as they were last year. However, while a larger supply of tankage and blood seems to be available, prices are holding at ceiling levels, and thus they go chiefly to the feed trade.

Ammoniates.—The animal by-products appear in greater supply, but producers still maintain full ceiling prices. The inorganic nitrogen materials continue in their routine way under the Government regulations.

Sulphate of Ammonia.—Additional quantities have been alloted to the trade for mixing purposes.

Nitrate of Soda.—Remains in fairly good supply, and is moving in the now well-worn groove under Government rules.

Superphosphate.—Concern felt for the supply position, although mixers in this section appear to receive sufficient for their requirements so far.

Bone Meal.—Demand continues to hold up, although more material seems to be available, and some users are able to now secure the material they need, which they were unable to do a year or so ago.

Potash.—The supply continues to keep pace with the demand.

Castor Pomace.—Still in a tight position, and supply not sufficient to meet the demand.

TENNESSEE PHOSPHATE

Farm and Mining Operations Pushed to Get Ahead of Approaching Winter. War Prisoners Not Available for Work Inside Plants.

Exclusive Correspondence to "The American Fertilizer"

COLUMBIA, TENN., October 16, 1944.

Normal fall weather, some bad, some good, has prevailed for the past two weeks, marked by the usual feverish activity of farmers to get hay and tobacco in the barn and fall plowing and seeding out of the way before winter sets in. Phosphate operators are striving to get as much crude material mined and in storage as possible against the approaching winter season, which all signs indicate will be earlier this year than usual.

Shipments continue moving actively into all channels of consumption. Operations are hampered by breakdowns of mills, bagging and loading equipment and by shortage of manpower which becomes more acute as men from this area are drawn into East Tennessee for the enormous war plant operations and construction.

With OPA ceilings limiting the selling prices and War Labor Board fixing the prices paid for labor in the phosphate industry, the quandary of the phosphate producer is obvious as he watches his best men drawn away to war contracts, even though theoretically frozen in their jobs at the phosphate plants. It was hoped that war prisoners could be used, but as they can only be worked outside and no provision for transportation is allowed in this area, the only use being made of them is in cutting cordwood for the wood distillation plants near the Lawrence County camp. A few are hauled fifty miles daily from the Coffee County camp by farmers trying to get their tobacco in the barn.

Almost everyone here is in favor of extension by Congress of the Tennessee Valley Authority to include the Cumberland River valley, and the establishment of similar enterprises for the Missouri and other regions. It is hoped that the TVA will at once provide for the three dams in Duck River which at a previously estimated cost of thirty-eight million dollars will develop 150,000 hp. and give year-round navigation to Columbia. This will put the Tennessee phosphate field on water-rate freight basis, and permit development of many thousand acres of phosphate land between Centerville and Columbia and west and north of Mt. Pleasant.

The saving in freight on the phosphate in the Duck River valley alone will pay the entire net cost of the TVA, leaving this priceless benefit free of charge to the immediate area or to taxpayers generally.

Shipments of ground phosphate rock in bulk are more and more generally being accepted by farmers, who realize that a little more work for them is more than made up by the price differential between bulk and bags.

Shipments of ground rock so far in 1944 exceed shipments for entire year of 1943, with tonnage for entire year of 1944 likely to be 30 per cent more than 1943, though still less than 70 per cent of total capacity, due to accidents and manpower shortage.

CHICAGO

No Improvement in Fertilizer Organic Market. Conditions in Feed Materials Market Expected to Change for the Better.

Exclusive Correspondence to "The American Fertilizer"

CHICAGO, October 16, 1944.

Excepting for the steady demand, and shortage of offerings, the organic market lacks any dominant features. The looked-for improvement in this situation has so far not developed.

In feeds, dry rendered tankage is offered more liberally, while wet rendered offerings are limited. Conditions in this department will undoubtedly improve, as Canada is not granting export permits now.

Ceiling prices are:

High grade ground fertilizer tankage, $3.85 to $4.00 ($4.68 to $4.86 per unit N) and 10 cents; standard grades crushed feeding tankage, $5.53 per unit ammonia ($6.72 per unit N); blood, $5.53 ($6.72 per unit N); dry rendered tankage, $1.25 per unit of protein, f. o. b. producing points.

WFA Estimates Prospective Fertilizer Supplies

Prospective supplies of nitrogen and phosphate fertilizers for use on 1945 crops have declined since midsummer, due to greatly increased military use of materials required for manufacture of those fertilizers, but substantially increased supplies of potash are expected to be available, the War Food Administration reported recently.

War Food officials pointed out that the War Production Board is facilitating early delivery of materials to manufacturers so that mixed fertilizers can be moved early. Movement of fertilizers to farms now will clear the way for use of additional materials in mixed fertilizers if supply situations improve in time for 1945 crops.

The nitrogen supply now regarded as certain is 588,000 tons. This includes the nitrogen in 850,000 tons of Chilean nitrate (16 per cent nitrogen) for which shipping priority has already been granted. The amount of nitrogen now regarded as "certain" for this year is approximately 43,000 tons less than was used for fertilizer last year (1943–44) but 220,000 tons more than average consumption in 1935–39.

Officials say that 7,000,000 tons of superphosphate (18 per cent equivalent) is "in sight," compared with 7,600,000 tons last year. The phosphoric acid content of this year's superphosphate supply is 1,260,000 tons compared with the 1935–39 average consumption of 758,000 tons.

The supply of potash (K_2O) will be materially larger than last year when a record amount was consumed. Officials expect 725,000 tons of K_2O compared with 604,000 tons last year and 1935–39 average consumption of 373,000 tons. The increase this year is expected to be in the form of muriate (potassium chloride) rather than sulphate of potash.

August Sulphate of Ammonia Production

The figures of the U. S. Bureau of Mines show that production of by-product sulphate of ammonia during August continued on practically the same level as during July, the total of 68,576 tons being only 409 tons less than the previous month. Sales during August came to 64,458 tons, while stocks on hand at the end of the month rose to almost 80,000 tons.

	Sulphate of Ammonia Tons	Ammonia Liquor Tons NH_3
Production		
August, 1944	68,576	2,664
July, 1944	68,985	2,601
August, 1943	65,368	2,900
January–August, 1944	543,614	21,228
January–August, 1943	504,259	22,738
Sales		
August, 1944	64,458	2,537
July, 1944	62,954	2,499
August, 1943	62,960	2,967
Stocks on hand		
August 31, 1944	79,462	631
July 31, 1944	75,378	650
August 31, 1943	42,407	1,028
July 31, 1943	40,034	956

Phosphate Plant for India Proposed

Establishment of a factory for large-scale manufacture of phosphatic fertilizers is being considered by the government of Madras, India, according to the U. S. Department of Commerce. It is proposed that domestic resources of phosphate estimated at several million tons be used as a raw material, using the manufacturing method developed by the Indian Institute of Science. This method does not require sulphuric acid and utilizes inexpensive raw materials.

Spanish Potash Production Lower in 1943

Spanish production of muriate of potash declined again in 1943, although not so noticeably as in the preceding year, when output was curtailed because of the decrease in domestic consumption. Total production of Union Espanola de Explosivos, Minas de Potasa de Suria, and Potasas Ibericas amounted to 87,000 metric tons of K_2O in 1943, compared with 117,000 in 1941, and 89,000 in 1942.

THE NEED FOR BORAX ON FOURTEEN CROPS

(Continued from page 16)

or not stem-end browning is corrected by borax in the field. That is not likely to be as simple as it sounds because the field use of borax does not guarantee its availability to the crop in the podzol soil region. Soils in some fields fix large amounts of boron out of reach of the crop, and field soils are often very spotty in their boron-fixing capacity. Hence, a number of trials on each soil would be needed with different rates and different placements of boron in the plant root zone to determine whether correction of stem-end browning could be obtained. Of course, there might also be other nutritional causes for the same sort of brown condition.

Leaf Roll and Net Necrosis

In each of the past two growing seasons an apparently non-parasitic, leaf-roll condition of the potato has been produced at the Vermont Station by extreme phosphorus starvation on a phosphorus-fixing soil and was corrected with phosphorus (6). The leaf roll resulting from extreme phosphorus starvation was indistinguishable from that present in our farm fields. Dr. Lutman, Pathologist, without knowledge of the fertilizer treatments, would have rogued out the phosphorus-starved plants as virus leaf roll had he encountered them in a farm field. Until we can learn more about it, we think that we should adopt the term, "apparently non-parasitic leaf roll" as has been suggested by Dennis. In Scotland, it is boron deficiency that sometimes produces leaf roll that is rogued out of the fields.

In the boron-deficiency experiment with potatoes described in this paper, an upward rolling of potato leaves was obtained and corrected with borax. Leaves, however, were muddy green in color, readily distinguishable from the virus leaf roll commonly prevalent in our farm fields. Our experiments, however, would not exclude the possibility of a leaf roll due to boron deficiency identical with virus leaf roll, at least in appearance.

Net necrosis tubers have repeatedly produced leaf roll plants in our experiments under ordinary field conditions, confirming again this commonly accepted fact. "Spindle sprout" potatoes also have repeatedly produced a typical virus leaf roll condition in field experiments, as some growers have come to suspect.

Further experiments are planned to try to find out if potato leaf roll, net necrosis, and stem-end browning, as they occur in the field, have nutritional aspects, boron or otherwise.

Ring Rot

Mention by Dennis in Scotland of boron-deficient potatoes with a burst surface brings to mind that we obtained some similar tubers five years ago in a pot experiment. We caused it by boron starvation on a boron-

See Page 4

fixing soil. Tubers with similar appearing breaks or cracked surfaces are pictured in Maine Ext. *Bulletin 286*, "Potato Ring Rot."

We do not know that there is any relation whatever between ring rot and boron deficiency. However, since rots of sugar beets, turnips, celery, and other crops are due to boron deficiency, it is interesting to compare boron deficiency and ring-rot symptoms as described by Bonds and Wyman of Maine. Some characteristics common to both are:

- Leaves rolled upward
- Leaves mottled (chlorotic)
- Leaves yellow or pale green
- More or less wilting
- Increase in dry weather
- Tops of plants injured first
- Death of whole or part of a plant
- Tuber affection without the top of the plant showing symptoms
- Tuber cracking
- Infection of vascular ring
- Bacterial and fungous invaders
- Dead areas in leaves
- Decayed tissues yellowish or brownish in color

Practically all of the symptoms of potato ring rot are very close to those known and expected in the potato from relatively severe phases of boron starvation, particularly those phases of boron deficiency corresponding to yellow top of alfalfa. Of the symptoms, only the contagious nature of ring rot would serve well to distinguish it from certain phases of boron deficiency. While the extreme similarity may be just a coincidence, experiments should be undertaken to see if boron fertilization reduces plant susceptibility to ring rot, or has any antiseptic action against the spread of potato ring rot, as it seems to have against early blight. Such experiments would seem easy; but to be conclusive, they will involve a considerable number of trials because of the possible poor plant availability of borax on soils in the podzol region.

Boron deficiency may well account for one or more of our troublesome potato diseases in the field, but we still have too little evidence to be certain which one. Greater experimental effort should be made to break down the barriers between nutrition and pathology.

HUMUS-THE WORKING PARTNER OF CHEMICAL PLANT FOOD

(Continued from page 12)

growth of a clean-culture crop such as corn or cotton, soil organic matter is destroyed very rapidly. If a variety of crops is grown as in a rotation, in which the proportion of clean-culture crops is not too large, it is possible to maintain the organic matter to a satisfactory level by supplementing with purely chemical fertilizers. This is done by promoting the growth of sod crops which are turned under and also by stimulating a larger growth of the clean-culture crops whose residues above and below ground are incorporated in the soil. The following data, given by Dr. F. E. Bear, illustrate this point. They show the relation between crop yields and organic matter content of soils at the end of a fifteen-year experiment involving manure, fertilizers, and lime on De Kalb silt loam soil. All the crops were harvested and removed so that the normal residues alone contributed to the organic matter supply.

TABLE 2

EFFECT OF FERTILIZERS ON ACCUMULATION OF ORGANIC MATTER
(Dr. F. E. Bear)

Treatment	Fertilizers Applied in 15 years tons per acre	Total Produce in 15 years lbs. per acre	Organic Matter in soil at end lbs. per acre
No fertilizer	None	40,960	42,800
Complete fertilizer	5	117,910	60,800
Manure	190	139,670	73,600
Complete fertilizer and lime	7.5*	120,605	49,000
Manure and lime	212.5	152,400	65,000

*2.5 tons burnt lime.

We see that 5 tons of complete fertilizer during the 15-year period produced an increase of over 40 per cent in the organic matter content per plowed acre of soil. Manure made a larger contribution but considering the huge amounts applied one would expect more. Dr. Bear, commenting on these re-

sults, observes that "soil organic matter is largely a by-product of good farming; the larger the crop, the more refuse for plowing under. Assuming that the rotation includes sod crops, the supply of organic matter in the soil can be maintained at a high level by the use of inorganic fertilizers alone."

Humus-Lime Fertilizer

There is not and should not be any conflict between fertilizer producers and their salesmen and those who favor and promote organic matter renewal. Humus is not indestructible. When it has become depleted commercial fertilizer becomes less effective. That is common farm experience. It is under such circumstances that some farmers may be inclined to blame the fertilizer salesman and his product. You know the usual line. "Your so-and-so fertilizer is not as good as it used to be. You must have changed your formula or done something. All I know is your fertilizer don't make me as big a crop as it used to." Very often the "something" lacking in the set-up is not in the fertilizer bag but in the amount of humus in the soil. If the organic matter is renewed in sufficient amounts the commercial fertilizer may safely be used in larger amounts and with greater expectancy of big yields.

It is my conviction that soil fertility can never be stabilized and kept up unless soil humus is maintained at a level normal for the region and soil type. This, in my judgment, represents the attitude of the commercial fertilizer industry. Humus renewal helps keep soils young and fertile, the humus tending to hold fertility and helping to keep the mineral elements in the fertilizer and lime in circulation. Drouth years may be even more calamitous if soil humus is badly depleted, because insufficient humus aggravates the handicap of an insufficient water supply. Commercial fertilizers used in liberal quantities help to grow large crops of green manure in the rotation which when turned under renew the humus supply. Fertilizers, lime, and organic matter complement one another. Each has a specific job to do but to succeed profitably they must work together—the perfect working partnership for a big harvest.

ECONOMICS OF USE OF DOLOMITE IN NEUTRAL-REACTING MIXED FERTILIZERS

(Continued from page 9)

attaches to the use of dolomite in making neutral mixed fertilizers *vs.* acid-reacting complete fertilizers. With this viewpoint we have no quarrel. It is based on things as they are, rather than on things as they might be, and hence is realistic. But dolomite is a product of very low unit-value. In the fertilizer bag it competes for space with plant-food carriers of very much higher unit-values. The real cost of the dolomite in mixed fertilizer is a function of space occupied in what is really an expensive package.

Ross and Mehring (*11*) have estimated the average cost of production, distribution and selling a ton of mixed fertilizer, excluding costs incident to plant-food carriers, as per the following:

Manufacturing Cost Exclusive of Raw Materials

Bags	$1.20	
Labor	1.00	
Overhead	2.25	
Taxes	.75	
Profit	1.00	
Total		$ 6.20

Distribution and Selling Costs

Selling Expense	$1.50	
Tag Tax	.25	
Freight	2.50	
Trucking	.75	
Dealer's Compensation	1.50	
Total		6.50
Total Basic Cost per Ton of Mixed Fertilizer		$12.70

These estimated costs look odd today, particularly those for bags and labor. Some of the costs may vary with the selling price of the goods, notably dealer's compensation. There is question whether the profit item should be included as a cost. There is no point, however, in attempting to arrive at a precise figure, for the estimate will still be an average made up of widely varying items. Perhaps we may take $10.00 as representing the total manufacturing, distribut-

ing and selling costs incident to mixed fertilizers, or one-half cent per pound for the contents of the bag. This figure cannot be far wrong.

Roughly, in mixed fertilizers carrying 4 per cent nitrogen, drawn from liquid carriers and sulphate of ammonia, some 300 pounds of dolomite is needed to produce a "neutral" fertilizer. Average cost of this dolomite at the fertilizer factory may be as high as $3.00 per ton, or 15 cents per hundred. On the basis of the foregoing estimate of the cost of the space inside the fertilizer bag, 45 cents worth of dolomite (300 pounds at 15 cents per hundred) must bear an overhead charge of $1.50, or a total cost for the 300 pounds of dolomite, under the assumption stated, of $1.95. This is dolomite at the rate of $13.00 per ton; and this certainly is not low-cost dolomite.

Or, to make our estimate comparable with other estimates presented in this paper, the 3.5 tons of $CaCO_3$ equivalent needed to neutralize a ton of average mixed fertilizer nitrogen, involves a cost of about $10.00 for the dolomite with some $35.00 for the space occupied.

Cost-accounting is an inexact science. We may for instance distribute the overhead cost of manufacturing, distribution and selling on the basis of input values of materials used rather than input weight. Such accounting may change our estimate of the cost of dolomite in mixed fertilizers, but can have no effect on actual costs involved. Or, we may figure, as many have figured, that because dolomite sometimes replaces sand, added cost in the making of a neutral fertilizer is confined to the difference in cost between sand and dolomite. Such reasoning certainly changes our estimate of costs, but not the actuality. The fact remains that the space inside the fertilizer bag is expensive; and that, when this space is occupied by dolomite, we have either high-cost dolomite, or an expensive package for our N, P, and K carriers.

Conclusions

1. The dolomite used as a neutralizing agent in complete mixed fertilizers is well serving a present need, at least when used in fertilizers for cotton.

2. The amount of neutralizing dolomite, which can reach the land through mixed fertilizers, is relatively small, when viewed either in relation to estimates of need of lime, or actual use of lime.

3. When figured on the basis of space occupied in the fertilizer bag, the dolomite reaching the land in neutral mixed fertilizers is high in cost to the consumer.

4. From the standpoint of economic considerations alone, the direct use of dolomite or limestone, coupled with the use of more concentrated acid-reacting mixed fertilizers, rather than of neutral mixed fertilizers, is indicated. This may represent a process of evolution in which the present neutral mixture is a transitory phase.

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(*3*) Anthony, J. L., John Pitner and Clarence Dorman, "Neutral Versus Acid Fertilizer," Mississippi Agricultural Experiment Station *Bulletin*, 338:12, 1940.

(*4*) *Ibid.*, page 2.

(*5*) *Ibid.*, page 7.

(*6*) *Ibid.*, page 13.

(*7*) *Assoc. Offic. Agr. Chem. Jour.* 19:68, 284–8, February, May 1936.

(*8*) Collins, E. R. and J. J. Skinner, "Effect of Dolomitic Limestone on Soils and Crops When Used as a Neutralizing Agent in Complete Fertilizers," *Jour. Amer. Soc. Agronomy* 34:894–901, October, 1942.

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(*10*) Mehring, A. L. and G. P. Vincent, "Fertilizer Consumption in 1941 and Trends in Usage," U. S. D. A. *Circular* 689:15, 1943.

(*11*) Ross, W. H. and A. L. Mehring, "Mixed Fertilizers," U. S. D. A. *Yearbook* 1938, page 540.

(*12*) Skinner, J. J., H. B. Mann and E. T. Batten, "Report on Acid and Neutral Fertilizer Experiments with Cotton in 1934," Natl. Joint Com. on Fert. Applic. Proc. 10:72–5 (Table 2), 1934. (Mimeographed and distributed by National Fertilizer Association.)

(*13*) *U. S. D. A. Report of Administrator of Agricultural Research*, 1943, page 218.

(*14*) *U. S. D. A. Report of Chief of A. A. A.*, 1943, pages 9–10.

(*15*) Williamson, J. T., "Efficiency of Ammoniated Superphosphates for Cotton," *Jour. Amer. Soc. Agron.* 27:724–8, September, 1935.

BUYERS' GUIDE • A CLASSIFIED INDEX TO ALL THE ADVERTISERS IN "THE AMERICAN FERTILIZER"

This list contains representative concerns in the Commercial Fertilizer Industry, Including fertilizer manufacturers, machinery and equipment manufacturers, dealers in and manufacturers of commercial fertilizer materials and supplies, brokers, chemists, etc.
For Alphabetical List of Advertisers, see page 33.

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Wellmann, William E., Baltimore, Md.

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Wellmann, William E., Baltimore, Md.

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